BLIND SPECTRUM SENSING BASED ON MAXIMUM CORRELATION COEFFICIENTS AND USE THEREOF

TECHNICAL FIELD

[0001] This invention relates generally to cognitive radio networks and, more specifically, relates to sensing the presence of primary users in cognitive radio networks.

BACKGROUND

[0002] This section is intended to provide a background or context to the invention disclosed below. The description herein may include concepts that could be pursued, but are not necessarily ones that have been previously conceived, implemented or described. Therefore, unless otherwise explicitly indicated herein, what is described in this section is not prior art to the description in this application and is not admitted to be prior art by inclusion in this section. Abbreviations that may be found in the specification and/or the drawing figures are defined below at the end of the specification but prior to the claims.

[0003] Conventional fixed spectrum-allocation policies lead to low spectrum usage in many frequency bands, and cognitive radio is a promising technology for exploiting the underutilized spectrum in an opportunistic manner.

[0004] For a cognitive radio networks (CRNs), terminals trying to communicate need to dynamically detect the presence of primary users (PUs). When PUs do not use frequency bands, the cognitive users (CUs) can access the frequency bands in a dynamic spectrum access (DSA) way. Otherwise, when the PUs use the frequency bands, the CUs must promptly withdraw the frequency bands to ensure that PUs can communicate properly without interference from CUs. Typically, the frequency bands will be licensed, but may also be unlicensed or meet other criteria (e.g., "lightly" licensed or shared).

[0005] Spectrum sensing (SS) is a fundamental task for cognitive radio systems, and detection statistics plays an essential role in the performance of SS algorithms. Practically, how to pursue an appropriate test statistic is a very challenging issue, because it directly affects the performance of the detection algorithm.

[0006] When a blind spectrum sensing is employed in cognitive radio, this type of sensing confronts some technical problems, such as:

[0007] There is no information of the noise power and the primary signal in some circumstances.

[0008] The sensing method has to have relatively small computation complexity; otherwise the method will increase the cost of the CR device.

[0009] The decision threshold for the sensing method has to be robust to the noise uncertainty.

[0010] The decision threshold for the sensing method has to be a non-asymptotic expression for any sample size and dimension.

[0011] On the other hand, blind sensing is beneficial, as this requires little or no knowledge of PUs and the frequency bands the PUs can use. Therefore, it would be beneficial to provide improved techniques for blind sensing of PUs in CR networks.

SUMMARY

[0012] This section contains examples of possible implementations and is not meant to be limiting.

[0013] In an exemplary embodiment, a method includes performing blind spectrum sensing of a frequency band to determine whether a primary user is using the frequency band The blind spectrum sensing is based at least in part on a comparison between a detection statistic based on a maximum correlation coefficient, for correlations between a plurality of signals corresponding to a plurality of snapshots taken by a cognitive radio of the frequency band and corresponding to a plurality of antennas used by the cognitive radio for taking the snapshots, and a detection threshold based on theoretical computation of a distribution of the detection statistic. The method includes determining whether to communicate using the frequency band based on whether the blind spectrum sensing indicates the frequency band is or is not used by the primary user.

[0014] In another exemplary embodiment, an apparatus includes: means for performing blind spectrum sensing of a frequency band to determine whether a primary user is using the frequency band, wherein the blind spectrum sensing is based at least in part on a comparison between a detection statistic based on a maximum correlation coefficient, for correlations between a plurality of signals corresponding to a plurality of snapshots taken by a cognitive radio of the frequency band and corresponding to a plurality of antennas used by the cognitive radio for taking the snapshots, and a detection threshold based on theoretical computation of a distribution of the detection statistic; and means for determining whether to communicate using the frequency band based on whether the blind spectrum sensing indicates the frequency band is or is not used by the primary user.

[0015] In a further exemplary embodiment, an apparatus includes one or more processors and one or more memories including computer program code. The one or more memories and the computer program code configured, with the one or more processors, to cause the apparatus to perform at least the following: performing blind spectrum sensing of a frequency band to determine whether a primary user is using the frequency band, wherein the blind spectrum sensing is based at least in part on a comparison between a detection statistic based on a maximum correlation coefficient, for correlations between a plurality of signals corresponding to a plurality of snapshots taken by a cognitive radio of the frequency band and corresponding to a plurality of antennas used by the cognitive radio for taking the snapshots, and a detection threshold based on theoretical computation of a distribution of the detection statistic; and determining whether to communicate using the frequency band based on whether the blind spectrum sensing indicates the frequency band is or is not used by the primary user.

[0016] An additional exemplary embodiment is a computer program product. The computer program product comprises a memory bearing computer program code embodied therein for use with a computer. The computer program code comprises: code for performing blind spectrum sensing of a frequency band to determine whether a primary user is using the frequency band, wherein the blind spectrum sensing is based at least in part on a comparison between a detection statistic based on a maximum correlation coefficient, for correlations between a plurality of signals corresponding to a plurality of snapshots taken by a cognitive radio of the frequency band and corresponding to a plurality of antennas used by the